PEACE/WILLISTON
FISH & WILDLIFE
COMPENSATION
PROGRAM

BCHydro

BRITISH
COLUMBIA

Cottonwood Tree Enhancement Trial: Enhancing Trees for Cavity-dependent Wildlife Year 1 (2002): Treatment Activities

F. B. Corbould and B. Booth
2003

PWFWCP Report No. 268

The Peace/Williston Fish & Wildlife Compensation Program is a cooperative venture of BC Hydro and the provincial fish and wildlife management agencies, supported by funding from BC Hydro. The Program was established to enhance and protect fish and wildlife resources affected by the construction of the W.A.C. Bennett and Peace Canyon dams on the Peace River, and the subsequent creation of the Williston and Dinosaur Reservoirs.

Peace/Williston Fish and Wildlife Compensation Program, 1011 Fourth Ave. 3rd Floor, Prince George B.C. V2L 3H9

Website: *www.bchydro.bc.ca/environment/initiatives/pwcp/*

This report has been approved by the Peace/Williston Fish and Wildlife Compensation Program Fish Technical Committee.

Citation: F. B. Corbould and B. Booth. 2003. Cottonwood tree enhancement trial: enhancing trees for cavity-dependent wildlife Year 1 (2002): treatment activities. Peace/Williston Fish and Wildlife Compensation Program, Report No. 268. 11pp plus appendices.

Author(s): Fraser B. Corbould[1] and Barry Booth[2]
Address(es): [1] Peace/Williston Fish and Wildlife Compensation Program, 1011 Fourth Ave., 3rd Floor Prince George, B.C. V2L 3H9
[2] Pure and Applied Wildlife Research, 2822 West King Edward, Vancouver, B.C. V6L 1T9

TABLE OF CONTENTS

INTRODUCTION 1
STUDY AREA AND DESIGN 2
METHODS 6
RESULTS 8
Treatment Trees 8
Retention Trees 8
Time to Conduct Treatment Activities 10
FUTURE MONITORING 10
ACKNOWLEDGEMENTS 11
REFERENCES 11
APPENDICES 12

INTRODUCTION

Large-diameter (≥50 cm) cottonwood trees (LDCT) often provide a number of structural habitat features that are used by a wide range of wildlife species (e.g., woodpeckers, owls, fishers, bats, diurnal raptors) to meet their reproduction, shelter, and foraging requirements. Structural habitat features provided by these LDCT include cavities, deeply furrowed bark, loose bark, large branches, large-diameter broken tops, and open-structured trees near open areas.

Cottonwood trees can develop heartwood decay (heartrot) at relatively young ages due to anaerobic conditions created by free-living bacteria in the heartwood, thereby allowing internal chambers (cavities) to potentially develop within the bole of older trees. Secondary cavity users (SCU) are birds and mammals that cannot excavate their own holes. Holes that enable SCU to access these inner cavities are usually created by primary cavity excavators or by natural tree decay or damage processes (e.g., lost branches, frost cracks).

To help mitigate the loss of expansive lowland areas due to reservoir flooding (i.e., areas where LDCT were numerous) and the continued loss of overmature LDCT due to forest management and safety practices, it may be possible to increase or accelerate the SCU use of LDCT that have not naturally attained a state that SCU would be able to use them under their current condition. Accordingly, if access routes were created through the hard outer bark and sapwood of LDCT, cavities would become accessible to SCU.

In 2001, an enhancement trial was proposed that would increase the number of cavities available to SCU in LDCT situated in logged and unlogged settings. The treatment design involved the creation of an access route – created by boring through the intact outer bole of the tree, to an already existing internal cavity in the LDCT. However, following a pre-treatment assessment that investigated over 100 LDCT in logged sites in the Parsnip, Crooked and Salmon River areas, only a couple LDCT had the structural attribute (internal chamber) required to meet the original objective (i.e., create access routes to internal chambers by boring through the outer sapwood).

As a result, a revised objective was proposed: determine if access routes (bored holes) created through the outer sapwood of LDCT will hasten the establishment of heartrot, and result in the creation of internal chambers that can be used by SCU. This report documents the enhancement trial activities that were conducted in 2002 to meet this new objective.

STUDY AREA AND DESIGN

The study area is situated adjacent to a tributary (Redrocky Creek) of the Crooked River, in the southern portion of the Williston Reservoir watershed (Figure 1). This study was designed to examine which tree feature (tree size or bole decay status) or hole characteristic (aspect) best dictate what trees become most susceptible to the formation of heartrot, and thus the creation of internal chambers. Therefore, in order to minimise the environmental factors that can potentially affect decay rates (e.g., regional climatic factors, aspect, elevation), trees were selected from sites in the same geographic area – as opposed to several sites in replicate study areas. The Redrocky study area was selected because of the sizeable number of large-diameter cottonwood trees present in both logged and forested settings, and its close proximity to Prince George (<80 km) and ease of vehicle access (highway and good gravel roads).

Within the Redrocky study area, treatment activities were conducted at two different locations; henceforth, referred to as the *upper* and *lower* Redrocky sites (Figure 2). Within the upper and lower sites, trees were selected from recently logged (<12 years old) and mature forest areas. At the upper Redrocky site, trees were selected from two cutblocks (Cutting Permit 896 Blocks 137 and 141) and the forested area between Blocks 137 and 139. At the lower Redrocky site, trees were selected from one cutblock (Cutting Permit 891 Block 92) and the adjacent forest at the north end of the cutblock. The majority (80%) of the trees selected for treatment were located in the upper Redrocky site.

Block 137 and Block 141 were both harvested from November 1994 to March 1996 by The Pas Lumber (Table 1). Block 92 was harvested during July through October 1991. Large-diameter, overstorey cottonwood trees had been retained sporadically throughout each cutblock, with some of these trees having already fallen by the time we initiated our enhancement trial. Loss of fallen trees was likely due to wind-throw in all three cutblocks.

Both the upper and lower Redrocky sites are situated in the wet, cool Sub-Boreal Spruce subzone (SBSwk1) (Table 1LumberDeLong 2003). Overall, the cutblocks were dominated by herbs, grasses and shrubs. Trembling aspen (*Populus tremuloides*) was the main deciduous shrub present. In Block 137 and Block 141, there was evidence of past manual hack-and-squirt efforts to retard aspen regeneration. Despite this effort, trembling aspen, as well as paper birch (*Betula papyrifera*) saplings, reached as tall as 2 m. Lodgepole pine

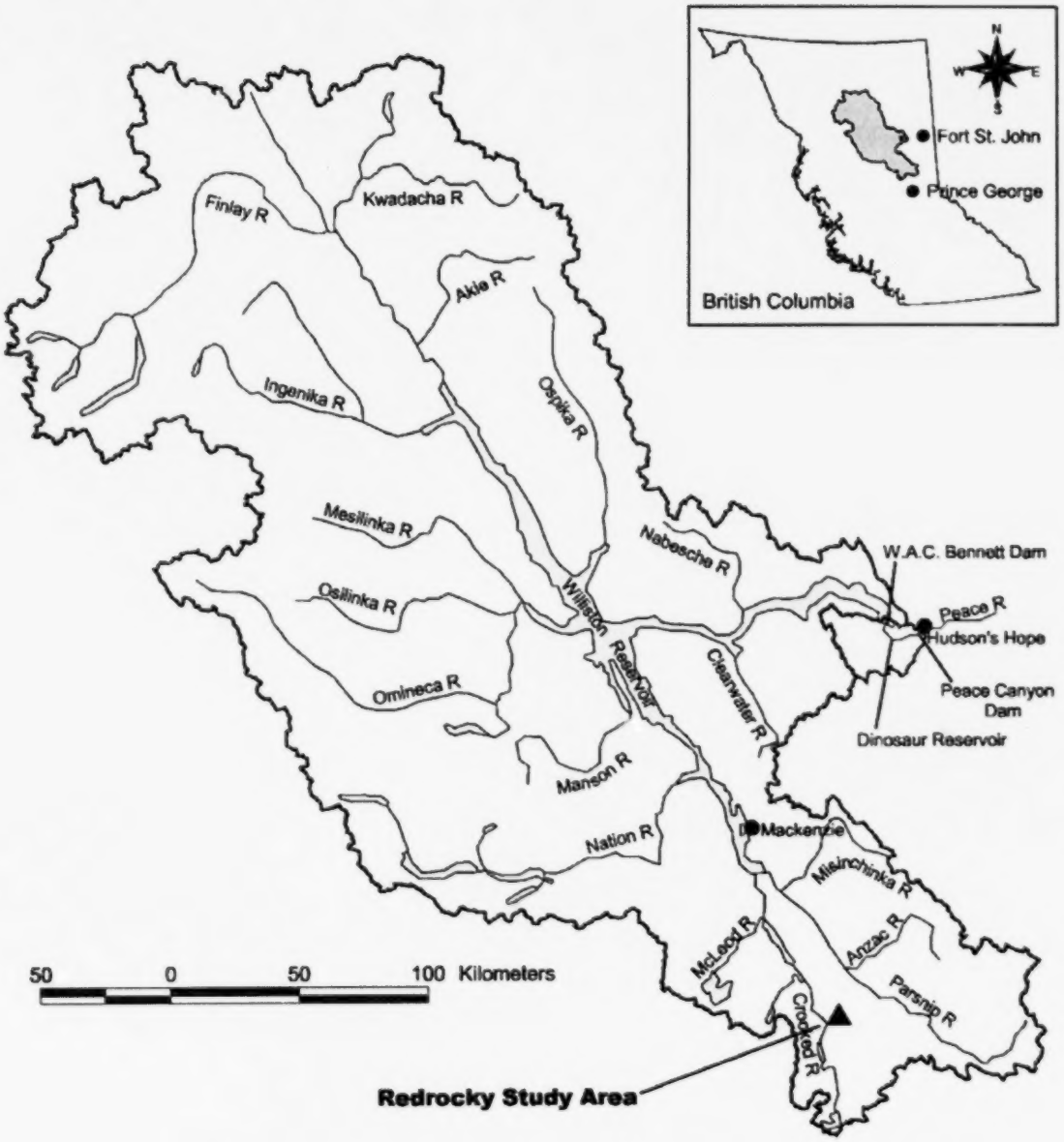


Figure 1. Location of the Redrocky study area within the Williston Reservoir watershed.

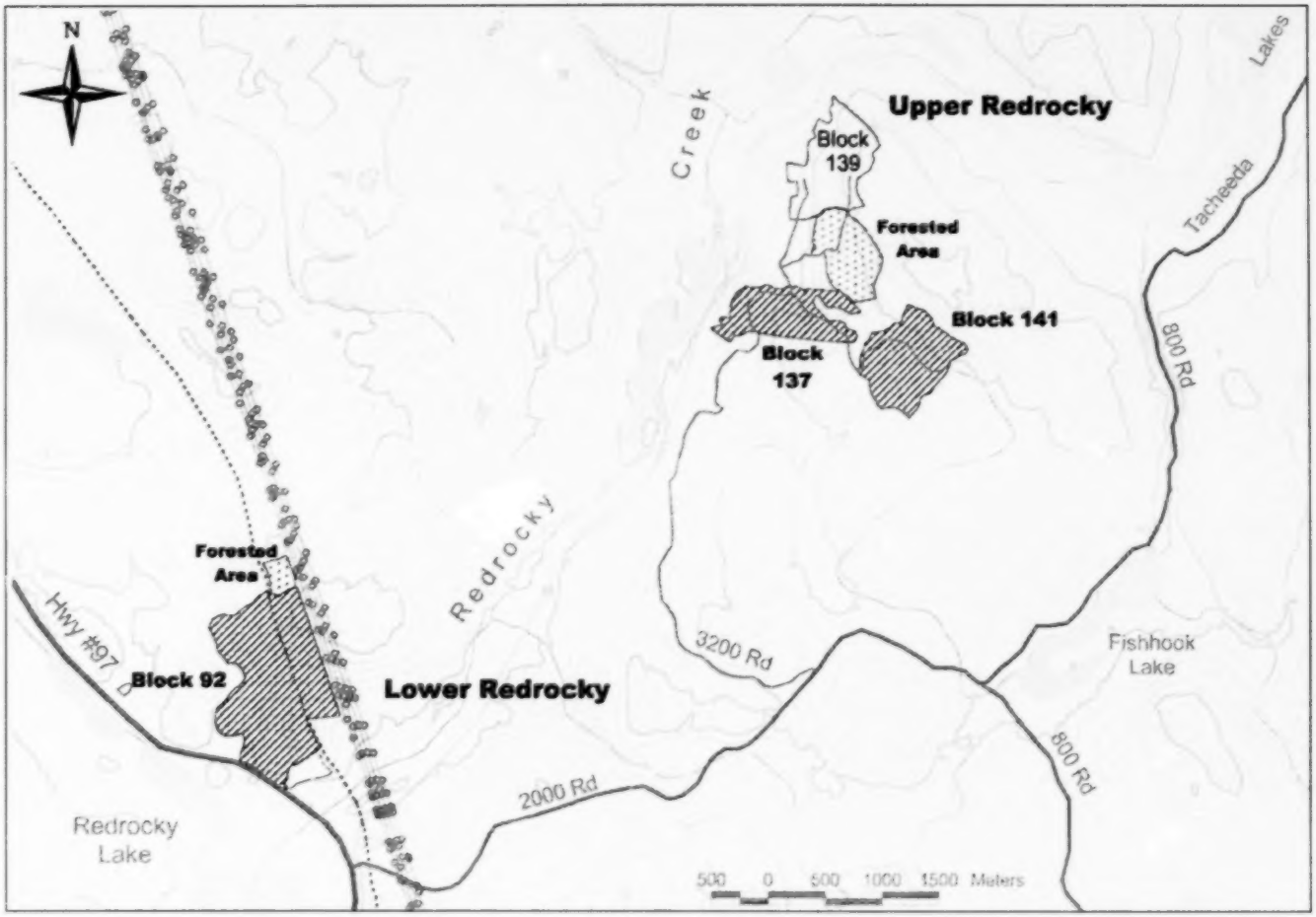


Figure 2. Upper (Block 137 and 141, and forested area) and lower (Block 92 and forested area) Redrocky sites within the Redrocky study area.

Table 1. Area and harvest characteristics for cutblocks within the Redrocky study area where large-diameter cottonwood trees were selected for treatment, fall 2002. Data were based on cutblock history information and maps provided by The Pas Lumber.

	Harvest Area (cutting permit & block)		
	Upper Redrocky		Lower Redrocky
	896-137	896-141	891-92
Area Characteristics			
Biogeoclimatic Unit	SBS wk1	SBS wk1	SBS wk1
Ecological Classification [a]	08b(10), 06(10) & 09(10)	03(10) & 07(8)08(2)	01(10)
Elevation	790 m	890 m	750 m
Cutblock History			
Harvest date	Nov/94 to Mar/96	Nov/94 to Mar/96	Jul-Oct/91
Harvest method	conventional	conventional	conventional
Size	43.2 ha	51.0 ha	100.4 ha
Mechanical site preparation	windrows 1995	windrows 1995	windrows 1992
Chemical treatment			Vision (backpack) 1996
Burn treatment	windrows & landings 1995-96	windrows & landings 1995-96	landings burned
Planting date & composition	Jun/96 Sx(83%),Pl(14%)	Jun/96 Sx (66%),Pl(33%)	Jun/93 Pl(55%), Sx(45%)

[a] Ecological Classification (site series) designations are only presented for those portions of the cutblock where trees were sampled. Codes are based on DeLong (2003), with composition (deci-percent) provided in brackets.

(*Pinus contorta*) and hybrid spruce (*Picea engelmannii x glauca*) has been planted throughout each of the cutblocks. In most cases, regenerating pine stems were below 2 m in height; however, in some sampled areas of Block 92, they reached as high as 2.5-3.0 m.

Forested stands where trees were sampled were mature to old-growth mixed wood stands comprised primarily of hybrid spruce (*Picea engelmannii x glauca*), lodgepole pine, subalpine fir (*Abies lasiocarpa*), and trembling aspen. Cottonwood trees occurred sporadically in the stands, typically associated with seepage sites and intermittent creek draws. Douglas fir (Pseudotsuga menziesii) was also present but only within the upper Redrocky site.

METHODS

Prior to commencing treatment activities, preliminary ground surveys were conducted to identify candidate cottonwood trees. Candidate trees were measured (diameter at breast height [dbh = 1.3 m]), and visually assessed for their health status (e.g., live, dead top) and location (e.g., proximity to cutblock-forest interface). Trees that were dead, or <50 cm or >120 cm dbh were not selected for treatment. An attempt was also made to select trees that were at least 15 m from a cutblock-forest interface (especially in forested settings), thus somewhat reducing the chance of environmental differences due to edge effects.

Sample trees were selected for treatment (drilling) such that roughly the same number of trees occurred in forested and logged settings. Preferably, only healthy trees (e.g., decay class 1) were selected for treatment, though some decay class 2 trees (e.g., partial dead tops) were included. Individual trees were paired within their respective cutblock or forest area based on similar stem diameters and their proximity to one another; attempts were made to keep paired tree differences to <10 cm in diameter and <150 m in distance apart.

Each tree had one hole drilled to, or slightly past, the core of the main bole using a Tanaka® TED-262R 26cc gas-powered drill with a 5-cm diameter , 75-cm long wood auger bit. Prior to drilling, the diameter of each tree was taken at the point where the hole was to be drilled in order to ensure that the proper depth of each hole was achieved; diameter measurements were made to the nearest 0.5 cm, with accuracy likely ±1-2 cm.. The aspect (north or south) of the first hole drilled for a pair of trees was selected at random, with the second tree's hole being drilled at the remaining aspect. Using a 12-foot extension ladder, the intent was to create holes as high as possible on the tree bole in order to make the sites most useable to SCU (e.g., reduced predation risk, above regenerating vegetation) without compromising safety concerns. Holes at these heights can be easily created without the need of setting up tree ascent equipment and fall protection measures. Instead, the ladder was used as a work platform with a body harness and ropes acting as a work positioning set-up. Holes were drilled as close to the same angle (slope) as possible. Hole slopes were measured using a clinometer to the nearest 1%, with an accuracy of likely ±2%.

An assessment of the decay state of each tree at the drilled hole was done by visual inspection. The colour and texture of the wood removed from each hole was described (Appendix 1) and recorded. Particular attention was paid to changes in the colour of the wood from the outside to the inside of the hole. In addition, any anomalies in wood colouration (e.g., different coloured spots, seams) were duly recorded, and the hardness of

the wood in each hole was assessed by means of tapping the walls and end of the hole with a 3-mm diameter steel rod.

A wide range of variables characterizing the outward appearance of each tree were also recorded (Appendix 2). These variables were collected in order to assess the potential for decay either present within the tree, or as places were decay organisms might enter the tree. In addition, core samples were taken at breast height for each drilled tree in order to determine tree age and assess the extent that internal decay was present. Core samples were assessed in a similar fashion to the interior of drilled holes. In each case both the colour and textures of extracted cores were examined for evidence of decay (i.e., soundness of wood). Cores were classified as being intact and sound (e.g., a tree age could be obtained due to soundness), intact but not sound (e.g., an entire core was extracted but a complete tree age will be impossible to determine due to wood decay at or near the centre of the tree), or incomplete and decayed (e.g., the increment bore went far enough into tree, but not all of core was extracted due to decay) (Appendix 3).

An extensive photographic record of the drilled hole and treated tree was also taken. Photographs included the following:

- the exterior and interior of each drilled hole;
- the tree bole in the vicinity of the drilled hole (approx. 2 m above and below);
- the tree from each cardinal direction, at a distance of about 20 m;
- the full tree, where possible; and
- any anomalies present on the bole or in the canopy of selected trees.

Within a 20 m by 20 m plot centred on each tree, the percent cover of elevated (2-5 m, 5-10 m, and >10 m) coniferous and deciduous vegetation was estimated. Slope, aspect, and tree position (meso-slope scale) were also measured.

Since it was observed that some of the retained LDCT in the study cutblocks had already fallen since logging had occurred, additional LDCT in both logged and forested settings were marked to assist us in estimating the long-term retention rates of LDCT. In particular, we are interested in assessing the potential disparity in the longevity of overstory LDCT under these two scenarios. Retention trees were selected from the same areas where treatment activities were conducted. The only restriction placed on their selection was that they had to have a diameter ≥50 cm dbh; therefore, trees could be live or dead, greater than 120 cm dbh, and their proximity to cutblock-forest interfaces did not matter. Numbered aluminium tags (300 series) were used to mark these trees.

RESULTS

Treatment Trees

Between 20 September and 4 November, 2002, 82 LDCT were treated, assessed, and tagged in the Redrocky study area (Table 2, Appendix 4). Sixty-six LDCT were treated within the upper Redrocky site and 16 within the lower Redrocky site.

The diameters (dbh) of treated trees ranged from 53 cm to 119 cm (Table 3). Although trees were paired based on their bole diameter, this was done independent of their size class (e.g., 58 cm could be matched with 62 cm). Therefore, there are not necessarily even numbers of trees within each size class. Individual tree characteristics (e.g., height, lean, tree decay characteristics, breast-height core sample description) were recorded and entered into an Excel spreadsheet (Cottonwood tree data – *[revision date]*.xls).

The mean height above ground of each hole averaged 4.6 m (s.e. = 0.02 m; range 4.1-5.1 m). The mean slope at which holes were drilled averaged 27.8% (s.e. = 0.4%; range 23-40%). Individual characteristics observed for each drilled hole (e.g., drilled core description, hole depth, hole exposure) were recorded, and entered into an Excel spreadsheet (Cottonwood tree data – *[revision date]*.xls).

Retention Trees

In addition to the treatment trees, 93 LDCT were tagged in both logged and forested settings within the upper and lower Redrocky sites to assist in monitoring tree retention rates (Table 4). The diameters of the retention trees ranged from 51 cm to 135 cm (Table 5).

Table 2. Number of large-diameter cottonwood trees, by study site and forest type, treated within the Redrocky study area, fall 2002

Study Site	Logged	Forested	Total
Upper Redrocky	28	38	66
Lower Redrocky	10	6	16
Total	38	44	82

Table 3. Number of large-diameter cottonwood trees, by diameter[a] class and forest type, treated within the Redrocky study area, fall 2002.

Diameter Class	Logged	Forested	Total
50.0 - 59.5 cm	4	7	11
60.0 - 69.5 cm	10	12	22
70.0 - 79.5 cm	9	7	16
80.0 - 89.5 cm	5	11	16
90.0 - 99.5 cm	5	3	8
100.0 - 109.5 cm	5	2	7
110.0 - 119.5 cm		2	2
120.0 - 129.5 cm			0
130.0 - 139.5 cm			0
Total	38	44	82

[a] Diameter of tree measured at breast height (approximately 1.3 m)

Table 4. Numbers of additional large-diameter cottonwood trees, by study site and forest type, tagged to assist in monitoring their long-term retention rates within the Redrocky study area, fall 2002.

Study Site	Logged	Forested	Total
Upper Redrocky	33	32	65
Lower Redrocky	18	10	28
Total	51	42	93

Table 5. Number of additional large-diameter cottonwood trees, by diameter[a] class and forest type, tagged to assist in assessing long-term retention rates of cottonwood trees in logged and forested settings, Redrocky study area, fall 2002.

Diameter Class	Logged	Forested	Total
50.0 - 59.5 cm	13	5	18
60.0 - 69.5 cm	9	7	16
70.0 - 79.5 cm	12	8	20
80.0 - 89.5 cm	8	7	15
90.0 - 99.5 cm	5	9	14
100.0 - 109.5 cm	1	3	4
110.0 - 119.5 cm	2	2	4
120.0 - 129.5 cm	1		1
130.0 - 139.5 cm		1	1
Total	51	42	93

[a] Diameter of tree measured at breast height (approximately 1.3 m)

Time to Conduct Treatment Activities

Time needed to conduct the treatment component of this project (identify candidate trees; conduct treatments; measure and describe tree, hole and habitat characteristics; tag retention trees) was 20 working days for a 2-person crew, based on a 10-hr work day. This included travel time (2-2.5 hrs per day) to and from Prince George, but excludes the time required to age the cored samples collected from the treatment trees.

On average, about 6 trees were treated per drilling day. For an individual tree, it took approximately 1-2 hrs to complete treatment activities (set-up the work positioning system, drill the hole, and measure and record relevant characteristics); the actual drilling took only about 2-3 minutes.

FUTURE MONITORING

The decay status of bored holes will be assessed in the fall at intervals of 1, 2 and 5 years after treatment: 2003, 2004, and 2007. The need for subsequent monitoring will be re-assessed after the Year 5 post-treatment assessment.

During each assessment interval, the characteristics of the drilled hole, tree, and surrounding vegetation will be recorded; a full photographic record will also be taken. Since post-treatment assessments of the drilled holes may be difficult to quantify thoroughly without further damaging the tree (e.g., boring) – which could also affect the rate of decay, assessments of drilled holes will be quantified at a coarse level using visual clues and a metal rod to determine wood soundness: for example, no or little sign of decay (wood is hard and has little discolouration), moderate rot present (wood is spongy and discoloured), significant rot present (wood is soft and crumbly and dark brown in colour). This coarse assessment level will, nonetheless, be adequate to determine if our main objective is met as the intent of the trial is to create significant heartrot such that internal chambers can be created.

Wildlife sign and use at, or near, the drilled holes will be recorded. As well, whether the hole can be used by SCU will be noted (i.e., has the hole grown over?).

ACKNOWLEDGEMENTS

We would like to thank Peter Forsythe, The Pas Lumber (Prince George), for providing information on where potential study sites might exist and for cutblock history information.

REFERENCES

DeLong, C. 2003. A field guide to site identification and interpretation for the southeast portion of the Prince George Forest Region. Land Management Handbook #51. Ministry of Forests, Victoria, BC. 273 pp.

APPENDICES

Appendix 1. Colour and texture codes used to describe drilled holes and breast-height core samples of treated cottonwood trees within the Redrocky study area, Sep-Nov 2002.

Colour code	Description
LBR	Light brown
MBR	Medium brown
DBR	Dark brown
CHOC BR	Chocolate brown
RBR	Reddish brown
RUBR	Rusty brown
ORB	Orangy brown
GBR	Grey brown
LBR – MBR	Both light and medium brown, but mostly medium brown (depicted by underlining)

Texture code	Description
Hard	Wood firm and structured; well formed shavings produced when drilling.
Spongy	Wood has structure but spongy when compressed; wood chips (rather than shavings) usually present when drilling
Crumbly	Wood has limited structure and crumbly when handled; no chips or shavings when drilling.
Soft	Wood has no structure.

Appendix 2. Codes and descriptions of variables used in the Excel database (Cottonwood tree data – *[revision date]*.xls) to enter the field data for tree location, tree, hole and habitat characteristics, Redrocky study area, Sep-Nov 2002.

Variable	Description
Date	date of data collection
Recorder	person that recorded the field notes, and measured the Tree Location, Tree, and Habitat Characteristics
Climber	person that conducted the drilling, and measured the Hole Characteristics
Tree Location Characteristics	
TAG_NUM	number of tag on tree
Area	Study area
CP	cutting permit
Block	cutblock number
GPS #	GPS designation
ORIG_NUM	original tree number during reconnaissance (candidate) tree assessments
Matchtree	tree that is paired with this tree
Type	stand type (CC – cutblock, FOR – forested area)
Dist_edge	distance to edge (m)
Bear_edge	bearing to edge (degrees)
Edge_type	Type of edge: timber, cutblock or right of way (gas or power line)
GPS_num_orig	GPS designation for which most accurate GPS location was recorded
error (m)	error of GPS location
rel_pos	where GPS was taken in relation to tree
Tree Characteristics	
Species	tree species
DBH	diameter (to nearest 0.5 cm) at breast height (1.3 m)
lean	approximate lean in degrees
l_bearing	direction (bearing) of lean
lean_loc	where on bole lean occurs
h_dist	distance from tree used in height measurement
%_top	percent slope to top of tree
%_bot	percent slope to bottom of tree or to part of tree used
Add_top	any addition to height required (e.g., if shot for ht measurement used tree tag, rope ht, or ladder ht)
Tree_ht	estimated tree ht
h_dist	distance from tree used in ht measurement
%_sap	percent slope to sapwood suckers
%_bot	percent slope to bottom of tree or to part of tree used
Add_sap	any addition to height required (e.g., if shot for ht measurement used tree tag, rope ht, or ladder ht)

Variable	Description
sap_ht	estimated ht to sapwood suckers
h_dist	distance from tree used in ht measurement
%_br	percent slope to bole branch
%_bot	percent slope to bottom of tree or to part of tree used
Add_br	any addition to height required (e.g., if shot for ht measurement used tree tag, rope ht, or ladder ht)
br_ht	estimated ht to bole branch
h_dist	distance from tree used in ht measurement
%_Fork	percent slope to major fork
%_bot	percent slope to bottom of tree or to part of tree used
Add_fork	any addition to height required (e.g., if shot for ht measurement used tree tag, rope ht, or ladder ht)
Fork_ht	estimated ht to major fork
Core_age	
C_heart	
C_sap	
DCL	decay class of tree
Top_cond	description of top condition
Top_comments	additional comments regarding top and bole
Scars	comments pertaining to scars, or other anomalies
Other_sign	Evidence of any other physical sign that could indicate decay, or decay factors
Broken limb	where broken limbs present (here limb refers to a branch > ~20 cm in diameter
D_limb	were any dead limbs present (see above defn for limb)
br_scar	were any branch scars present (a branch scar is the remnant of a large branch or limb that has broken off roughly flush with the bole)
stubs	were any branch stubs present (a branch stub is the remnant of a large branch or limb that has broken off but is protruding from the bole)
root damage	was there any evidence of damage to roots
mech scars	was there any evidence of mechanical damage to the bole
woodpecker	was there any evidence of woodpecker foraging (o=old foraging, n=new foraging)
insectsign	was there any evidence of insect activity (o=old activity, n=new activity)
bear	was there evidence of bear claw marks
burl	were any burls present
cavity	were any cavities present
cavity_com	comments pertaining to cavities
other	other sign or damage to trees
bark annom	what bark anomalies were present
fungi	was fungi present on bole
Hole Characteristics	
Hole_DBH	dbh at point where hole was drilled
Hole_HT	ht from ground at point where hole was drilled
Depth	depth of hole (cm)

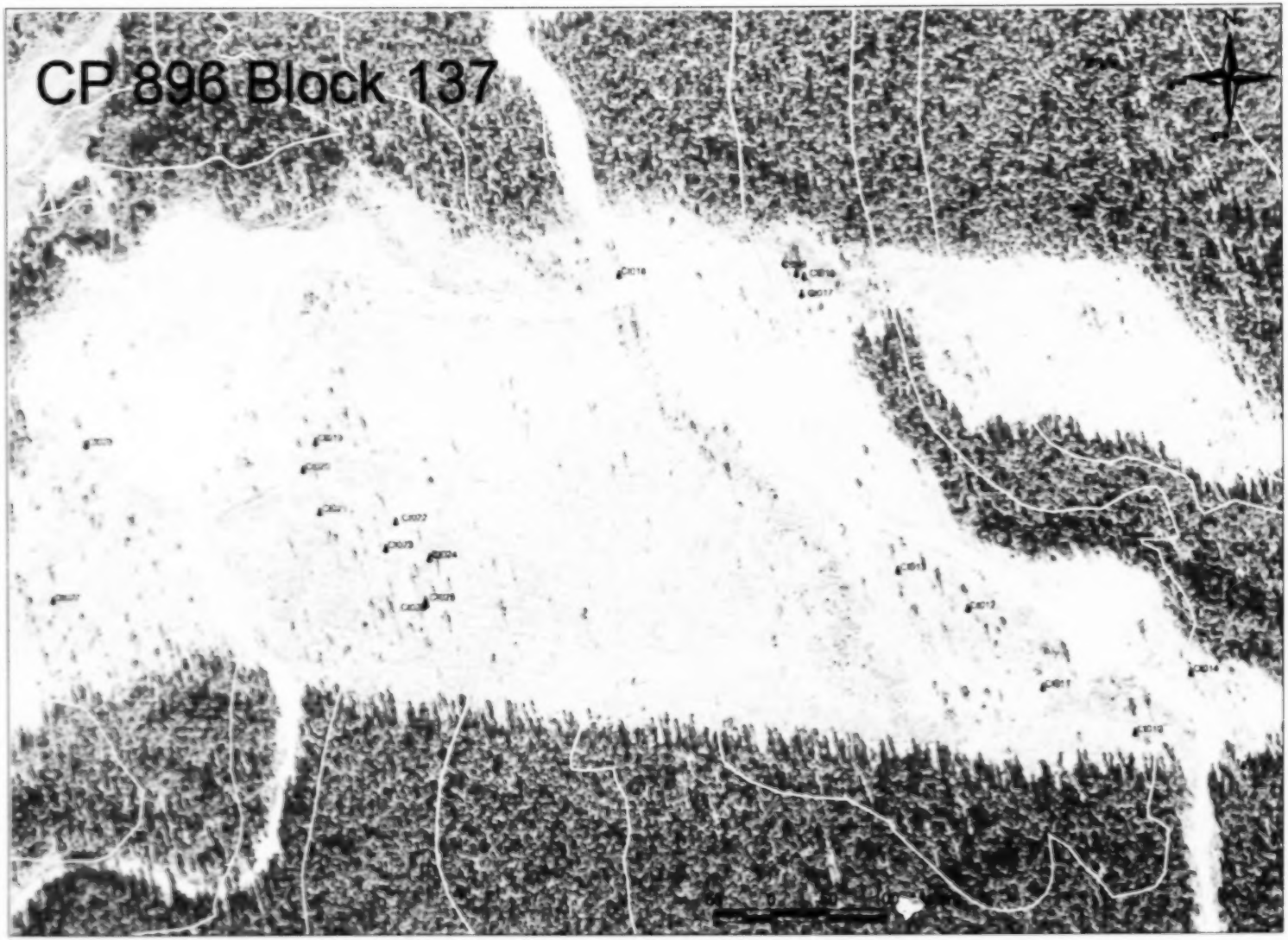
Variable	Description
Aspect_hole	aspect of hole (N or S)
Angle_hole	angle hole was drilled on
Exposure	estimate of exposure at/around hole (1 open -- 4 obscured)
Hardness	estimate of hardness of interior of hole: HT = hard throughout
Hard_com	comments associated with hardness: SM_E = small mark at end due to initial testing, TF=too far to hit hard enough
depth 2	depth recorded during second examination of the holes of some trees
l_clr_h	length of core that has clear
l_hole_s2	length of core in section 2 (towards centre)
col_cs2	colour of section 2 of core sample (see Appendix 3)
l_cs3	length of core in section 3 (towards centre)
col_cs3	colour of section 3 of core sample (see Appendix 3)
l_cs4	length of core in section 4 (towards centre)
col_cs4	colour of section 4 of core sample (see Appendix 3)
Hole_desc1	description of interior hole take from data sheets
Hole_desc2	description of interior hole take from data sheets
Hole_desc3	description of interior hole take from data sheets
Anom_1	description of anomalies noted in interior of hole: OC is the "o'clock" position, e.g., 7 OC = the 7 o'clock position
Anom_2	further anomalies
Anom_3	further anomalies
Hole_com	any additional comments regarding the hole of note
Habitat Characteristics	
BGC_unit	biogeoclimatic unit (e.g., SBSwk1)
SS	site series code, if available
Succ	forest successional stage (1 [herb] to 7 [old-growth forest])
Meso	meso-slope: CR=crest, UP=upper slope, MD=middle slope, LW=lower slope, TO=toe of slope, DP=depression, LV=level
Slope	in percent
Aspect	in degrees
Elev	elevation (metres)
Soil	surficial material, if available
decid_2-5	percent cover of deciduous 2-5 m
con_2-5	percent cover of coniferous 2-5 m
tot_2-5	total cover 2-5 m
decid_5-10	percent cover of deciduous 5-10 m
con_5-10	percent cover of coniferous 5-10 m
tot_5-10	total cover 5-10 m
decid_10+	percent cover of deciduous 10 = m
con_10+	percent cover of coniferous 10 = m
tot_10+	total cover 10 = m
site_com	comments pertaining to the site

Variable	Description
Core Characteristics	
Length of core	length of core taken
Coretype	type of core (see Appendix 3)
l_clr	length of the clear section of the core
l_cs2	length of section 2 of the core (towards the centre of the tree)
col_cs2	colour of section 2 of core sample (see Appendix 1)
l_cs3	length of section 3 of the core (towards the centre of the tree)
col_cs3	colour of section 3 of core sample (see Appendix 1)
l_cs4	length of section 4 of the core (towards the centre of the tree)
col_cs4	colour of section 4 of core sample (see Appendix 1)
l_cs5	length of section 5 of the core (towards the centre of the tree)
col_cs5	colour of section 5 of core sample (see Appendix 1)
Core_anom1	description of any anomalies in core sample
Core_anom2	description of any anomalies in core sample
Core_com	comments regarding core
Core_com2	further comments regarding core

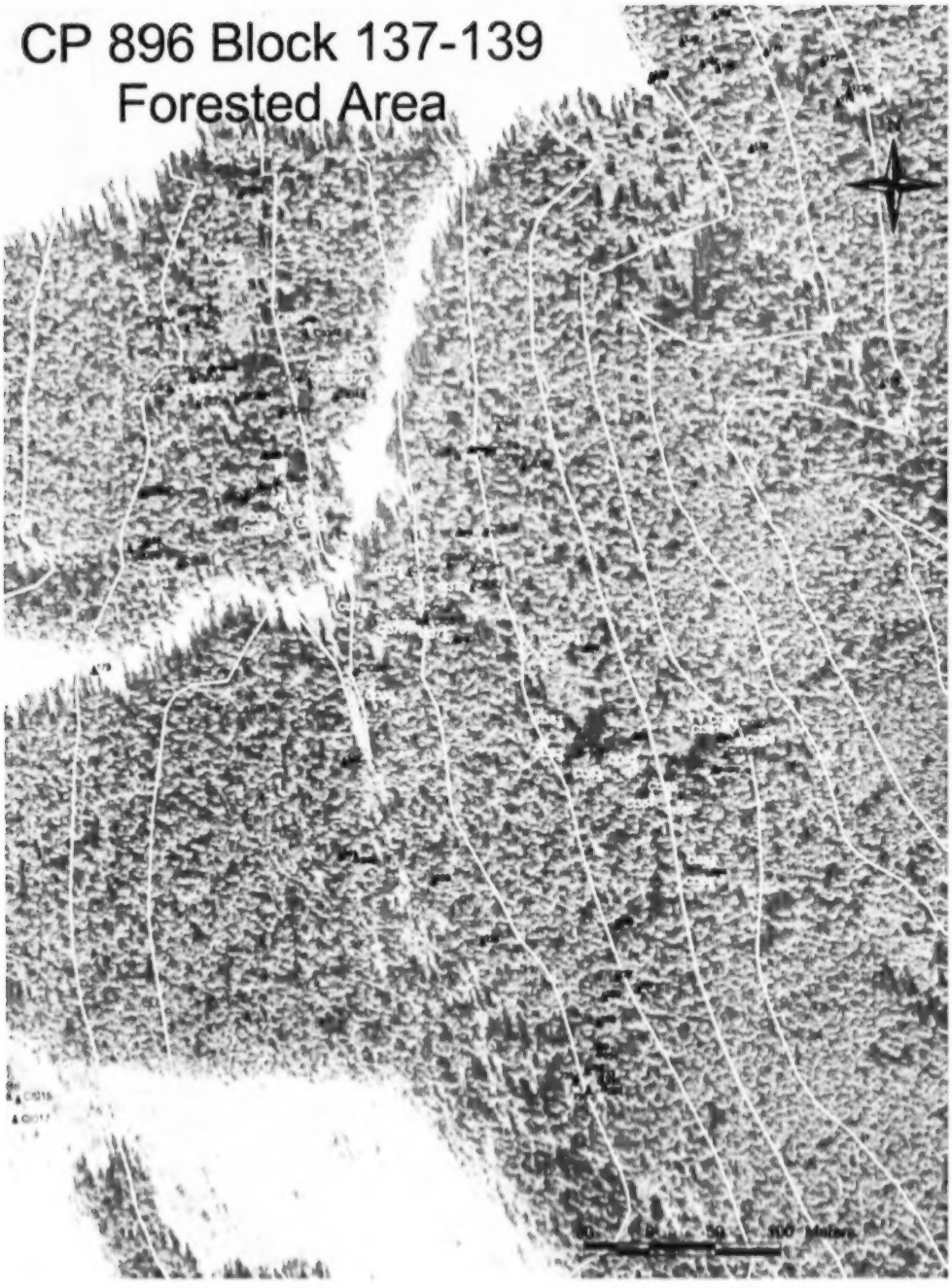
Appendix 3. Core type definitions used to describe breast-height core samples of treated cottonwood trees within the Redrocky study area, Sep-Nov 2002.

Core type	Description
1	core sound and fully extracted; ageing possible
2	entire core extracted but complete ageing not possible due to wood decay (e.g., centre decayed, section of rotten wood);
3	portion of core missing; increment bore went far enough into tree, but complete core was not extracted due to significant decay; ageing not possible

Appendix 4. Maps of cutblocks and forested areas in the upper and lower Redrocky sites, indicating locations of treated (000 series in red) and retention (300 series in yellow) cottonwood trees, Redrocky study area, Sep-Nov 2002.


CP 896 Block 137

CP 896 Block 137-139
Forested Area



CP 891 Block 92
N
50
0
50
100 Meters